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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/670,183	09/24/2003	Mehrdad Nikoonahad	5589-02326 P688-04C	9132

35617 7590 11/18/2005

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ART UNIT	**PAPER NUMBER**
2863	

DATE MAILED: 11/18/2005

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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

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GROUP 2800

Application Number: 10/670,183
Filing Date: September 24, 2003
Appellant(s): NIKOONAHAD ET AL.

Ann Marie Mewherter
Reg. No. 50,484
For Appellant

EXAMINER'S ANSWER

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

Excerpt from Peter Van Zani, MICROCHIP FABRICATION: A PRACTICAL GUIDE TO SEMICONDUCTOR PROCESSING, Fourth Edition, New York, New York, McGraw-Hill, 2000, pp 598.

Excerpt from S Wolf et al., SILICON PROCESSING FOR THE VLSI ERA: VOLUME 1- PROCESS TECHNOLOGY, Sunset Beach, California, Lattice Press, 1986, pp 447.

Excerpt from HANDBOOK OF SILICON SEMICONDUCTOR METROLOGY, Alain C Diebold, New York, New York, Marcel Dekker, Inc., 2001, pp 377.

Excerpt from WEBSTER'S II NEW RIVERSIDE UNIVERSITY DICTIONARY, Boston, Massachusetts, Houghton Miffin Company, 1984, pp 748.

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims: The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless -
(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country. more than one year prior to the date of application for patent in the United States.

Claims 6633 and 6635-6651 rejected under 35 U.S.C. 102(b) as being anticipated by Aspnes et al. (US 5,900,939) (Hereafter referred to as Aspnes).

Aspnes teaches:

A spectroscopic ellipsometer configured to generate one or more output signals during measurement of a specimen in regard to claim 6633

(e.g.; column 3, lines 45-50; figure 1, element 18);

A processor coupled to a spectroscopic ellipsometer and configured to determine a critical dimension and a thin film characteristic of a specimen from one or more output signals in regard to claim 6633

(e.g.; column 4, lines 26-27; figure 1, element 48);

A system is integrated into a process tool in regard to claim 6635

(e.g.; column 3, lines 45-50; figure 1);

A spectroscopic ellipsometer is configured to illuminate a specimen at an oblique angle of incidence in regard to claim 6636

(e.g.; column 5, lines 49-52; figure 1);

A spectroscopic ellipsometer is configured to illuminate a specimen at an oblique angle of incidence with a light beam comprising visible and ultraviolet light in regard to claim 6637

(e.g.; column 3, lines 51-55; column 5, lines 32-34; figure 1);

A spectroscopic ellipsometer is configured to illuminate a specimen at a normal angle of incidence in regard to claim 6638

(e.g.; figure 1 , elements, 20 and 30);

A spectroscopic ellipsometer is configured to illuminate a specimen at a normal angle of incidence with linearly polarized light in regard to claim 6639

(e.g.; column 6, lines 41-51; figure 1);

A spectroscopic ellipsometer is configured to illuminate a specimen at a normal angle of incidence with polarized light in regard to claim 6640

(e.g.; column 3, lines 55-63; figure 1);

A spectroscopic ellipsometer is configured to illuminate a specimen at a normal angle of incidence with polarized, visible light in regard to claim 6641

(e.g.; column 3, lines 55-63; figure 1);

A spectroscopic ellipsometer is configured to focus light to a small spot on a specimen in regard to claim 6642

(e.g.; column 5, lines 11-13; figure 1);

A processor is configured to use a thin film characteristic to determine a critical dimension in regard to claim 6643

(e.g.; column 4, lines 58-62; figure 1, element 48);

A system is coupled to a stand-alone metrology or inspection system, and the systems are configured such that signals may be sent between the systems in regard to claim 6644

(e.g.; column 3, lines 40-44 ; figure 1);

A thin film characteristic comprises optical properties of one or more layers on a specimen in regard to claim 6645

(e.g.; column 8, lines 24-28; figure 1);

A critical dimension comprises a lateral dimension of a feature on a specimen defined in a direction substantially parallel to an upper surface of a specimen, a lateral dimension of a feature defined in a direction substantially perpendicular to the upper surface of a specimen, or a sidewall angle of a feature in regard to claim 6646

(e.g.; figure 8);

A specimen comprises a wafer in regard to claim 6647

(e.g.; column 6, lines 61-64; figure 1, element 4);

A specimen comprises a substrate suitable for fabrication of a reticule in regard to claim 6648

(e.g.; column 6, lines 62-65; figure 1, element 4);

A spectroscopic ellipsometer configured to generate one or more output signals during measurement of a wafer is integrated into a lithography track in regard to claim 6649

(e.g.; column 3, lines 45-50; figure 1, element 18);

A processor coupled to a spectroscopic ellipsometer and configured to determine a critical dimension and a thin film characteristic of a wafer from one or more output signals in regard to claim 6649

(e.g.; column 4, lines 58-62; figure 1, element 48);

A spectroscopic ellipsometer is configured to illuminate a specimen at an oblique angle of incidence with a light beam comprising visible and ultraviolet light in regard to claim 6650

(e.g.; column 3, lines 51-55; column 5, lines 32-34; figure 1);

And a spectroscopic ellipsometer is configured to illuminate a specimen at a normal angle of incidence with polarized, visible light in regard to claim 6651

(e.g.; column 6, lines 41-51; figure 1).

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless -
(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shaĩl have the effects for purposes of this subsection of an application 5led in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claim 6634 is rejected under 35 U.S.C. 102(e) as being anticipated by Stanke et al. (US 6,563,586) (Hereafter referred to as Stanke).

Stanke teaches:

A spectroscopic ellipsometer configured to generate one or more output signals during measurement of a specimen in regard to claim 6633

(e.g.; column 9, lines 32-34);

A processor coupled to a spectroscopic ellipsometer and configured to determine a critical dimension and a thin film characteristic of a specimen from one or more output signals in regard to claim 6633
(e.g.; column 13, lines 7-14);

And a system is configured as a stand-alone device in regard to claim 6634
(e.g.; column 3, lines 55-58).

(10) Response to Argument

Rejection under 35 U.S.C. §102(b) over Aspnes

A. Claims 6133, 6636-6637, 6642 and 6645-6647

1. A critical dimension as presently claimed is not equivalent to a critical metric as this term is used in the Specification.

Appellant defines a critical dimension as "a lateral dimension of a feature defined in a direction substantially parallel to an upper surface of the specimen such as width of (a) feature on (a) specimen" and "<u>may also include a lateral dimension of a feature defined in a direction substantially perpendicular to an upper surface of the specimen such as height of (a) feature on (a) specimen</u>" (see Supplemental Appeal Brief, 4 April 2005, page 4, lines 2-4). Examiner interprets height of a feature (see The American Heritage® Dictionary of the English Language: Fourth Edition. 2000 : thickness: **1.** The quality or condition of being thick. **2.** The dimension between two surfaces of an object, usually the dimension of smallest measure. **3.** A layer, sheet, stratum, or ply) on a specimen as a determination of the thickness of the layer or substrate and as such comprises a critical dimension as defined by the appellant.

Further, appellant states, "critical metrics of a lithography process may include a property such as, but are not limited to, critical dimensions of features formed by the lithography process and overlay misregistration. Critical metrics of a process, however, may also include any of the properties as described herein including, but not limited to, a presence of defects on the specimen, a thin film characteristic of the specimen, a flatness measurement of the specimen, an implant characteristic of the specimen, an adhesion characteristic of the specimen, a concentration of an elements in the specimen." (see Supplemental Appeal Brief, 4 April 2005, page 5, lines 6-12). Examiner therefore interprets critical metrics, as defined and used by the appellant, broadly includes critical dimensions.

2. Aspnes does not teach or suggest a processor coupled to a spectroscopic ellipsometer that is configured to determine a critical dimension of a specimen from one or more output signals generated by the spectroscopic ellipsometer.

Appellant argues Aspnes fails to teach or suggest a processor configured to determine a critical dimension (see Supplemental Appeal Brief, page 6, lines 6-9). Appellant admits Aspnes teaches a processor configured to determine a thin film thickness (see Supplemental Appeal Brief, 4 April 2005, page 6, lines 12-13). Examiner interprets determination of the thickness of a layer or substrate as such comprises a critical dimension as defined by the appellant. Further, examiner notes Aspnes teaches a processor coupled to a spectroscopic ellipsometer that is configured to determine a critical dimension of a specimen from one or more output signals generated by the spectroscopic ellipsometer (see Aspnes US 5,900,939 column 5, lines 41 et seq and column 6, lines 1-10).

3. The Examiner has failed to support a ground of anticipation of claim 6633 by Aspnes.

Appellant argues Aspnes fails to teach or suggest a spectroscopic ellipsometer configured to generate one or more output signals during measurement of the specimen; and a processor coupled to the spectroscopic ellipsometer and configured to determine a critical dimension and a thin film characteristic of the specimen from the one or more output signals. For the reasons noted and cited in 1 and 2 above examiner maintains Aspnes anticipates claim 6633.

B. Claims 6635 and 6649-6650

Aspnes does not teach or suggest a system that is configured to determine at least two properties of a specimen and that is integrated into a process tool.

Aspnes teaches a "Composite optical measurement system 1 includes a Beam Profile Ellipsometer (BPE) 10, a Beam Profile Reflectometer (BPR) 12, a Broadband Reflective Spectrometer (BRS) 14, a Deep Ultra Violet Reflective Spectrometer (DUV) 16, and a Broadband Spectroscopic Ellipsometer (BSE) 18." (see column 3, lines 45-50) and "The processor 48 receives the output of the detector arrays 54/56, and derives the thickness and refractive index of the thin film layer 8 based on these angular dependent intensity measurements by utilizing various types of modeling algorithms." (column 4, lines 58-62) which examiner interprets as teaching a system that is configured to determine at least two properties of a specimen and that is integrated into a process tool.

C. Claims 6638-6641

Aspnes does not teach or suggest a spectroscopic ellipsometer configured to illuminate a specimen at a normal angle of incidence

Aspnes teaches "Composite optical measurement system 1 includes a Beam Profile Ellipsometer (BPE) 10, a Beam Profile Reflectometer (BPR) 12, a Broadband Reflective Spectrometer (BRS) 14, a Deep Ultra Violet Reflective Spectrometer (DUV) 16, and a Broadband Spectroscopic Ellipsometer (BSE) 18. These five optical measurement devices utilize as few as two optical sources: laser 20 and white light source 22. Laser 20 generates a probe beam 24, and white light source 22 generates probe beam 26 (which is collimated by lens 28 and directed along the same path as probe beam 24 by mirror 29). Laser 20 ideally is a solid state laser diode from Toshiba Corp. which emits a linearly polarized 3 mW beam at 673 nm. White light source 22 is ideally a deuterium-tungsten lamp that produces a 200 mW polychromatic beam that covers a spectrum of 200 nm to 800 nm. The probe beams 24/26 are reflected by mirror 30, and pass through mirror 42 to sample 4." (see column 3, lines 45-61; figure 1, elements 20, 22, 24 and 26) wherein examiner notes probe beams 24 and 26 are impinging specimen surface at a normal angle of incidence.

D. Claim 6643

Aspnes does not teach or suggest a processor that is configured to use a thin film characteristic of a specimen to determine a critical dimension of the specimen.

Aspnes teaches "The processor 48 receives the output of the detector arrays 54/56, and derives the thickness and refractive index of the thin film layer 8 based on these angular dependent intensity measurements by utilizing various types of modeling algorithms." (column 4, lines 58-62; figure 1, element 48) which examiner interprets as teaching a processor that is configured to use a thin film characteristic of a specimen to determine a critical dimension of the specimen.

E. Claim 6644

Aspnes does not teach or suggest a system configured to determine at least two properties of a specimen that is coupled to a stand-alone metrology or inspection system.

Aspnes teaches "The present invention is a composite thin film optical measurement system 1 having a wavelength stable reference ellipsometer 2 that is used, in conjunction with a reference sample 4 having a substrate 6 and thin film 8 with known compositions, to calibrate non-contact optical measurement devices contained in the composite thin film optical measurement system 1.

(3) FIG. 1 illustrates the composite optical measurement system 1 that has been developed by the present assignees, which includes five different non-contact optical measurement devices and the reference ellipsometer 2 of the present invention." (column 3, lines 33-44; figues 1 and 4) which examiner interprets as teaching a system configured to determine at least two properties of a specimen that is coupled to a stand-alone metrology or inspection system.

F. Claim 6648

Aspnes does not teach or suggest a system configured to determine at least two properties of a substrate suitable for fabrication of a reticle.

Aspnes teaches "The advantage of the present invention is that a reference sample having no thin film thereon, or having thin film thereon with an unknown thickness which may even vary slowly over time, can be repeatedly used to accurately calibrate ultra-sensitive optical measurement devices." (column 9, lines 61-65) which the examiner interprets as a specimen comprising a substrate suitable for fabrication of a reticle.

G. Claim 6651

Aspnes does not teach or suggest a spectroscopic ellipsometer configured to illuminate a specimen at a normal angle of incidence.

Aspnes teaches "Composite optical measurement system 1 includes a Beam Profile Ellipsometer (BPE) 10, a Beam Profile Reflectometer (BPR) 12, a Broadband Reflective Spectrometer (BRS) 14, a Deep Ultra Violet Reflective Spectrometer (DUV) 16, and a Broadband Spectroscopic Ellipsometer (BSE) 18. These five optical measurement devices utilize as few as two optical sources: laser 20 and white light source 22. Laser 20 generates a probe beam 24, and white light source 22 generates probe beam 26 (which is collimated by lens 28 and directed along the same path as probe beam 24 by mirror 29). Laser 20 ideally is a solid state laser diode from Toshiba Corp. which emits a linearly polarized 3 mW beam at 673 nm. White light source 22 is ideally a deuterium-tungsten lamp that produces a 200 mW polychromatic beam that covers a spectrum of 200 nm to 800 nm. The probe beams 24/26 are reflected by mirror 30, and pass through mirror 42 to sample 4." (see column 3, lines 45-61; figure 1, elements 20, 22, 24 and 26) wherein examiner notes probe beams 24 and 26 are impinging specimen surface at a normal angle of incidence.

Rejection under 35 U.S.C. §102(e) over Stanke

Claim 6634

1. A critical dimension as presently claimed is not equivalent to a critical metric as this term is used in the Specification.

Appellant defines a critical dimension as "a lateral dimension of a feature defined in a direction substantially parallel to an upper surface of the specimen such as width of (a) feature on (a) specimen" and "may also include a lateral dimension of a feature defined in a direction substantially perpendicular to an upper surface of the specimen such as height of (a) feature on (a) specimen" (see Supplemental Appeal Brief, 4 April 2005, page 4, lines 2-4). Examiner interprets height of a feature (see The American Heritage® Dictionary of the English Language: Fourth Edition. 2000: thickness: **1.** The

quality or condition of being thick. **2.** The dimension between two surfaces of an object, usually the dimension of smallest measure. **3.** A layer, sheet, stratum, or ply) on a specimen as a determination of the thickness of the layer or substrate and as such comprises a critical dimension as defined by the appellant (see Supplemental Appeal Brief, 4 April 2005, page 5, lines 6-12).

Further, appellant states, "critical metrics of a lithography process may include a property such as, but are not limited to, critical dimensions of features formed by the lithography process and overlay misregistration. Critical metrics of a process, however, may also include any of the properties as described herein including, but not limited to, a presence of defects on the specimen, a thin film characteristic of the specimen, a flatness measurement of the specimen, an implant characteristic of the specimen, an adhesion characteristic of the specimen, a concentration of an elements in the specimen." (see Supplemental Appeal Brief, 4 April 2005, page 5, lines 6-12). Examiner therefore interprets critical metrics, as defined and used by the appellant, broadly includes critical dimensions.

2. Stanke does not teach or suggest a processor coupled to a spectroscopic ellipsometer that is configured to determine a critical dimension of a specimen from one or more output signals generated by the spectroscopic ellipsometer.

Stanke teaches "Exemplary alternative embodiments include a profilometer to determine amounts of recess, dishing, or other departures from planarity of a wafer surface and a profilometer in combination with a reflectometer. In different embodiments, a profilometer may be an acoustic profilometer or an optical profilometer. A particular embodiment of an optical profilometer may use the auto-focus system described in U.S. Provisional Application Ser. No. 60/125,462, to determine a relative profile of a wafer surface. The auto-focus system is inherently sensitive to the profile of the wafer surface since departures from planarity of the wafer surface will cause differences in the focusing of light rays reflected from the wafer surface.

(35) Other embodiments of this wafer metrology device may include an ellipsometer or high-contrast imaging microscopes." (column 9, lines 19-35).

3. The Examiner has failed to support a ground of anticipation of claim 6634 by Stanke.

Appellant argues Stanke fails to teach or suggest the system is further configured as a stand-alone device in regard to claim 6634. Examiner notes Stanke teaches "The embodiment shown in FIG. 1 may be integrated as a subsystem into a process device (not shown) or in other embodiments may be a stand-alone mainframe." (column 3, lines 55-58).

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

DNW, 18 October 2005

Conferees:

Darren Schuberg, John Barlow

DNW

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